The SahulCHAR Collection: A Palaeofire Database for Australia, New Guinea, and New Zealand

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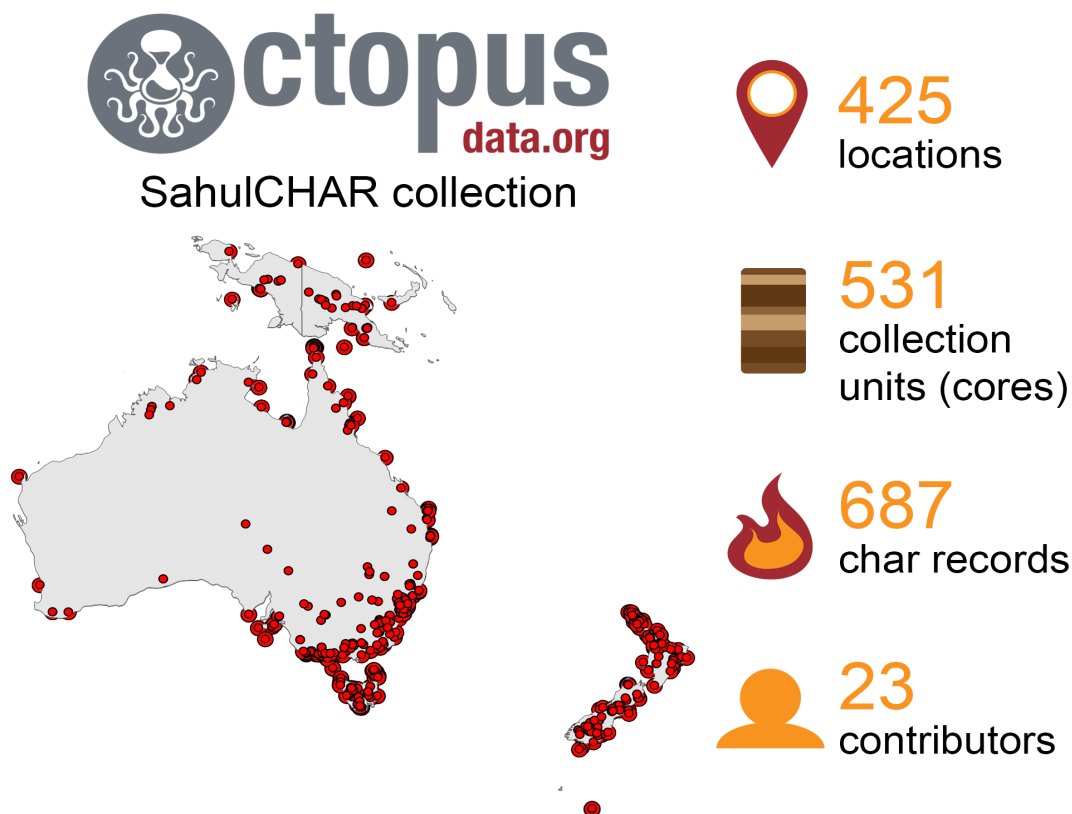
Non-technical summary (max. 500 characters): This paper presents SahulCHAR, a new collection of palaeofire (ancient fire) records from Australia, New Guinea, and New Zealand. SahulCHAR Version 1 contains 687 records of sedimentary charcoal or black carbon, including digitized data, records from existing databases, and original author-submitted data. SahulCHAR is a much-needed update on past charcoal compilations that will also provide greater representation of records from this region in future global syntheses to understand past fire.

Abstract. Recent global fire activity has highlighted the importance of understanding fire dynamics across time and space, with records of past fire (palaeofire) providing valuable insights to inform current and future management challenges. New records from the recent increase in palaeofire studies from Australia and surrounds have not been captured in any database for broader comparisons, and Australasia is poorly represented in current international databases used for global modelling of palaeofire trends. These problems are addressed by SahulCHAR, a new collection of sedimentary charcoal and black carbon records from Sahul (Australia, New Guinea, and offshore islands) and New Zealand. Data are stored in the OCTOPUS relational database platform, with a structure designed for compatibility with the existing Global Paleofire Database. Metadata are captured at site-level and observation-level, with observations including age determinations and charcoal or black carbon data. SahulCHAR Version 1 contains 687 records of charcoal or black carbon, including digitized data, unchanged and modified records from the Global Paleofire Database, and original author-submitted data. SahulCHAR is a much-needed update on past regional palaeofire compilations that will also provide greater representation of records from Sahul and New Zealand in future global syntheses.

Graphical abstract:

1 Introduction

Fire is a key ecosystem process with characteristics that vary widely across biomes globally, with "fire-dependent" ecosystems covering around half of the terrestrial globe (Shlisky et al., 2007, p. 6). Recent increases in global fire activity, including extreme fires in Australia and elsewhere, have highlighted the critical importance of understanding fire dynamics across time and space (Duane et al., 2021; Nolan et al., 2021), with more extreme fire weather predicted in the future for south-eastern Australia and northern and eastern New Zealand as a result of climate change (Lawrence et al., 2022).

Palaeofire data (sedimentary charcoal and black carbon, defined as carbonaceous substances of pyrogenic origin) can offer important insights into past fire variability to inform current and future challenges, including climate-fire-vegetation interactions (Williams & Abatzoglou, 2016; Marlon, 2020). Compilations of palaeofire records have been used to investigate long term relationships and shifting dynamics between humans, fire, vegetation, and climate in Australia (Lynch et al., 2007; Enright & Thomas, 2008; Williams et al., 2015), New Zealand (McWethy et al., 2010; Perry et al., 2014), and Indonesia and Papua New Guinea (Haberle et al., 2001). Understanding fire regimes over long timescales in Australia and the surrounding region has increasingly become a research priority, reflected in a recent influx of new palaeofire records (for examples from just the previous two years, see Adeleye et al., 2023; Constantine et al., 2023; Hanson et al., 2022; Laming et al., 2022; Patton et al., 2023; Rowe et al., 2022; Thomas et al., 2022). However, the last major compilation and synthesis of sedimentary charcoal records from Australasia was Mooney et al. (2011, 2012), containing 224 sedimentary charcoal records. These records were primarily derived from the Global Paleofire Database version 2 2 (GPDv2, Daniau et al. 2012) and version 2.5 (GPDv2.5. Marlon et al., 2013, 2016). These records are now included in the Global Paleofire Database (GPDv4, Power et al., 2010). More recent syntheses have been focused on specific regions, such as Mariani et al.'s (2022) compilation of over 100 charcoal records from south-eastern Australia contained in the GPD to investigate human-fire-vegetation dynamics over the last thousand years. The diverse environments of Australia, New Guinea, and New Zealand have unique histories of fire-climate-human interactions (Mooney et al., 2011). As identified by Mooney et al. (2011) and Rowe et al. (2023), no individual palaeofire record should be considered representative of this vast region; to disentangle long-term influences on fire and potential variations across subregions and ecosystems, a large dataset is required.

Major global databases containing charcoal data such as the GPD, the Reading Palaeofire Database (RPD; Harrison et al., 2022), Neotoma Paleoecology Database (Neotoma; Williams et al., 2018), and PANGAEA (Feldner et al., 2023) are lacking many palaeofire records from Australasia. The GPD currently contains 179 cores with associated charcoal data from Australia, 23 cores from New Guinea (Papua New Guinea and West Papua), and 10 cores from New Zealand. These records are also contained in the RPD, and even fewer cores from this region are available in Neotoma (17 cores) and PANGAEA (11 cores, 6 of which are also contained in the GPD). The GPD is a valuable resource for regional and global palaeofire syntheses (e.g., Daniau et al., 2012; Karp et al., 2021; Marlon et al., 2013, 2016) but it requires a significant update to capture the many new palaeofire records now available from Australia, New Guinea, and New Zealand. As noted by Harrison et al. (2022), current

88 limitations of the GPD include potential duplicates of sites, missing metadata and age data, and necessary updates to
89 incorporate newly published records. The GPD also contains lengthy yet still incomprehensive lists of metadata options, in
90 part due to the array of ways to approach charcoal analysis (e.g., Mooney & Tinner, 2010; Turner et al., 2004) as well as ad
91 hoc user additions and structural constraints (most notably a single field for measurement units that includes size ranges).

92 These limitations are addressed for Sahul (Australia, New Guinea, and continental islands) and New Zealand by the
93 SahulCHAR data collection (Rehn et al. 2024). The purpose of this paper is to introduce the data structure of SahulCHAR and
94 provide an overview of data compiled in Version 1. In keeping with existing OCTOPUS collections, SahulCHAR was named
95 and intended to have a geographic focus on the Sahul landmass (Australia, New Guinea, and continental islands); during data
96 collection, the geographic scope was extended to include New Zealand. SahulCHAR data collection was designed to capture
97 new records published since the compilation by Mooney et al. (2011, 2012), to capture older records not previously entered in
98 the GPD, to check (and correct, if required) details of records in the GPD from this region, and to capture additional metadata
99 wherever possible for records available in the GPD. To avoid replicating potential errors contained in the GPD, all data from
100 the GPD were carefully screened during data entry for SahulCHAR. Published sources – including but not limited to sources
101 listed in GPD records – were used to modify and add to metadata and charcoal data captured in the GPD wherever possible,
102 as part of a greater literature review to identify charcoal records in the region.

103 **2 Data structure and compilation**

104 SahulCHAR is hosted on the OCTOPUS platform (https://octopusdata.org), with data stored in a relational PostgreSQL
105 database (Figure 1). For a full description of the OCTOPUS v.2 system architecture, see Codilean et al. (2022), and for a full
106 and up-to-date OCTOPUS documentation, see Munack et al. (2023). For compatibility and future integration, the data structure
107 of SahulCHAR is broadly based on the metadata captured in the Global Paleofire Database (GPD) and structured to comply
108 with requirements of the OCTOPUS platform. Data in SahulCHAR, according to the OCTOPUS database model, are captured
109 at SITE, UNIT, SAMPLE and OBSERVATION levels, with not all UNIT types being cores (e.g., archaeological excavations,
110 sediment monoliths). This is shown in Figure 1, where shared database structure in kept clearly visible while database structure
111 dedicated to other compilations is shadowed out. Following the protocol used by the GPD, unnamed cores are assigned a
112 CORE name consisting of their associated site name and the suffix '_core1', '_core2', etc.

113

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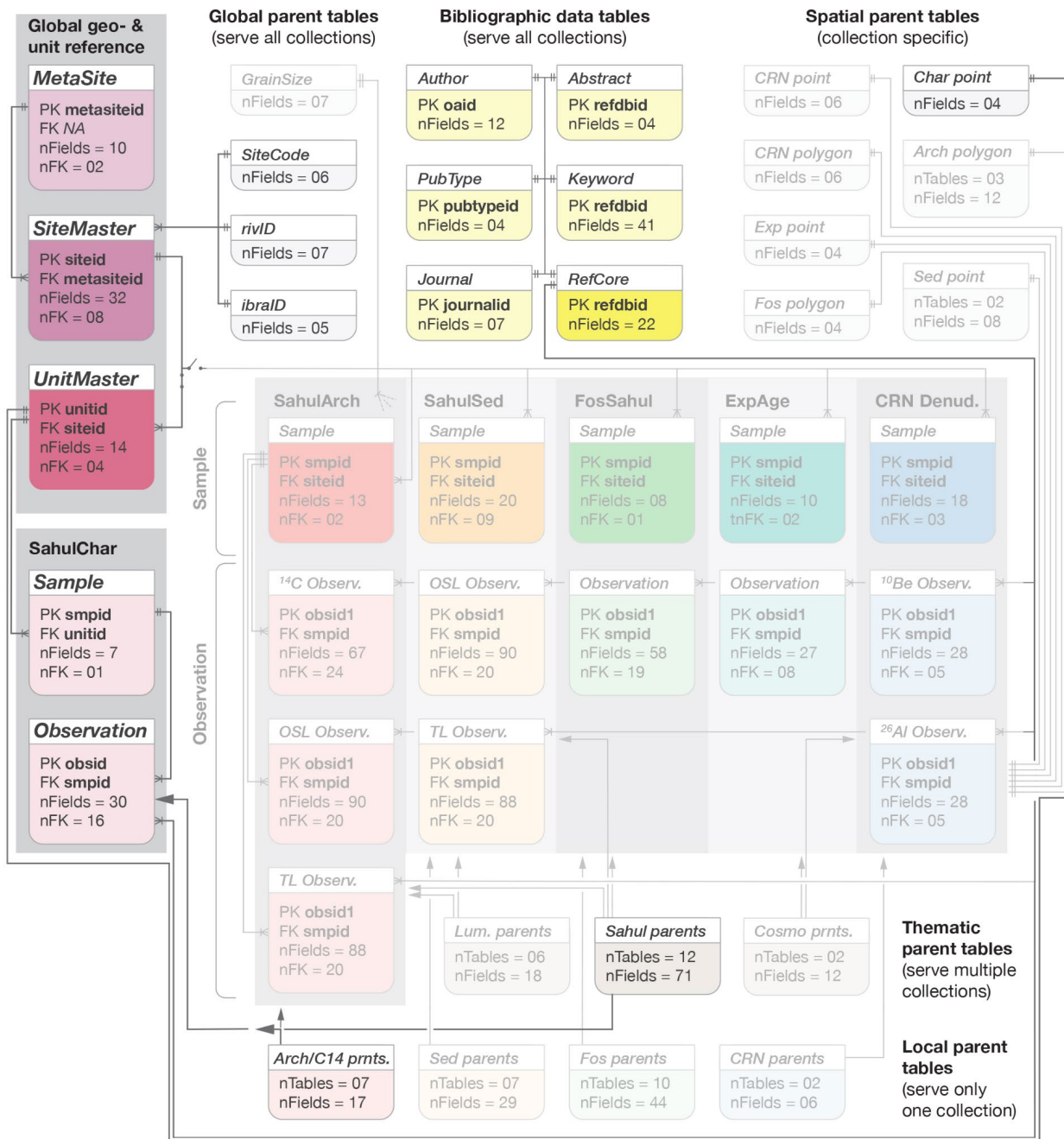
Figure 1: Graphical representation of the OCTOPUS semantic database model featuring the fully integrated SahulCHAR partner collection. SahulCHAR shares parent/lookup tables with the other collections (SahulArch, SahulSED, the IPPD, FosSahul, ExpAge, and CRN) on global, regional, and bibliographic level.

118   **Table 1:** Table representation of site-level metadata collected for SahulCHAR attributes vs corresponding GDP fields, where
119   applicable. For full description of database tables refer to Munack et al. 2023.

Metadata field	Description	Field type	Example	Corresponding GPD field
METASITE	Metasite name	Free text	Big Willum Swamp	*NA*
SITE	Site name	Free text	Big Willum Swamp BWIL2	site_name
COUNTRY	Country where metasite is located	Predefined list	Australia	country_name
SITECODE	Site type, based on primary characteristics at the time of collection	Predefined list	e.g terrestrial, bog. For full list; global-sitecode-fields	site_type_desc
BASIN	Basin size	Predefined list	large (50.1-500 km²) For full list; basinsizeid-fields	basin_size_desc
CATCHMENT	Catchment size	Predefined list	small (<10 km²) For full list; catchmentsizeid-fields	catchment_size_name
FLOWTYPE	Water flow type	Predefined list	closed - no inflow or outflow For full list; flowtypeid-fields	flow_type_name
BIOME	Surrounding biome type	Predefined list	For full list, global-biomeid-fields	biome_type_name
CORE	Name of collection unit, such as a core or excavation square	Free text	BWIL2	core_name
X_WGS84	Longitude	Numeric (in decimal degrees)	141.998466	longitude
Y_WGS84	Latitude	Numeric (in decimal degrees)	-12.656479	latitude
ELEVATION	Elevation above sea level	Numeric (in metres)	28	elevation
CORDS_ELEV	Source of coordinates and elevation data	Predefined list	INTP_INTP	*NA*

WATERDEPTH	Water depth at time of sampling	Numeric (in metres)	3.5	water_depth
COREDATE	Sampling date	Date (dd/mm/yyyy)	01/07/2017	coring_date
CORETYPE	Method used to collect the sample	Predefined list	piston corer	core_type
DEPOS_TYPE	Depositional context type	Predefined list	alluvial sediment	depo_context

120

2.1 Site-level metadata

122 Site-level metadata fields, descriptions, and examples are presented in Table 1; for complete documentation including available
123 options for predefined lists, see https://octopus-db.github.io/documentation/data_tables.html#global-georeferencing-tables
124 and https://octopus-db.github.io/documentation/data_tables.html#non-cosmogenics-tables. Location data are captured in two
125 forms: metasites and sites. Metasites are area-based (such as a lake) and stored as polygons, while sites are point-based (such
126 as a specific coring location in a lake) and stored as coordinates in decimal degrees. Metasites may have multiple associated
127 sites.

128 Basin and catchment metadata in SahulCHAR (BASIN and CATCHMENT) have been limited to broad categories that do not
129 require numeric values as these data are not often known. Vegetation metadata were limited to broad categories for the major
130 biome surrounding the site (BIOME) as multiple vegetation fields would require extensive list options to be comprehensive.
131 The available options for predefined lists were based on options available in the GPD, with additions where necessary; these
132 changes were informed by author-submitted data.

2.2 Unit to Observation-level metadata

134 Fields shared across all observation-level data are CORE (core or sample name), OBSID1 (internal OCTOPUS identifier,
135 incorporating CORE and identified as 'char' or 'age'), SMPID (internal OCTOPUS identifier, incorporating CORE and
136 DEPTH), DEPTH, THICKNESS, and references (REFDBID). Observation-level data include ages and charcoal or black
137 carbon records.

2.2.1 Age metadata

139 Age metadata collected in SahulCHAR are presented in Table 2; for complete documentation including available options for
140 predefined lists, see https://octopus-db.github.io/documentation/data_tables.html#sahulchar-tables. The predefined list options
141 are based on options available in the GPD, with the exception of the METHOD field which uses an existing OCTOPUS parent

142 table (see https://octopus-db.github.io/documentation/parent_tables.html#cabah-methodid-fields) to allow for a larger range
143 of options. In line with existing OCTOPUS collections of radiometric ages (such as SahulArch; Saktura et al., 2023), during
144 data entry for Version 1, preference was given to uncalibrated rather than calibrated radiocarbon ages where possible, to allow
145 for recalibration with future calibration curve updates. Ages reported in calendar years BC/AD or BCE/CE were converted to
146 'years BP' prior to entry or entered as AGE_UNIT = 'other' if conversion is not possible. Ages generated from dating methods
147 that are measured as years prior to sample collection and do not require calibration, such as lead-210 or optically stimulated
148 luminescence, were converted to 'years BP' prior to entry where possible or entered as AGE_UNIT = 'other'.

149 **Table 2:** Table representation of Age metadata collected for SahulCHAR attributes vs corresponding GDP fields, where
150 applicable. For full description of database tables refer to Munack et al. 2023.

Metadata field	Description	Field type	Example or available list	Corresponding GPD field
CORE	Name of collection unit, such as a core or excavation square	Free text	BWIL2	core_name
OBSID1	Unique identifier for observation	Text	BWIL2_0.05_age	NA
SMPID	Unique identifier for sample	Text	BWIL2_0.05	id_sample
DEPTH	Sample depth (mid-point) in metres	Numeric (in metres)	0.01	depth_value
THICKNESS	Sample thickness in centimetres	Numeric (in centimetres)	1	*NA*
LABID	Laboratory ID code for age	Free text	OZX-211	laboratory number
AGE	Age value	Numeric	760	age_value
AGE_ERROR	Age error value	Numeric	20	*NA*
AGE_UNIT	Measurement unit for age and age error	Predefined list	radiocarbon years BP	age_units_type
METHOD	Dating method used to generate age	Predefined list	Radiocarbon dating	age_type_name
MATERIAL	Material dated	Predefined list	bulk sediment, peat	Mat_dated_type

| REFDBID1, REFDBID2, REFDBID3 | A unique identifier for associated references using the surname of the first author, year of publication, and a keyword (Name:YEARkeyword) | Text | Rehn:2020thesis, Rehn:2021cape | *NA* |

151

2.2.1 Charcoal and black carbon metadata

153 Charcoal and black carbon metadata collected in SahulCHAR are presented in Table 3; for complete documentation including
154 available options for predefined lists, see https://octopus-db.github.io/documentation/data_tables.html#sahulchar-tables.
155 Charcoal and black carbon (hereafter referred to collectively as 'char') observations may share the same SMPID as age
156 observations, if they are taken from the same depth. Predefined lists are based on options available in the GPD, except for the
157 CALCURVE and CALPROGRAM fields, as the closest corresponding fields in the GPD ('calibration_curve_version' and
158 'calibration_method_type', respectively) appear as blank dropdowns in the GPD data upload interface and contain no values
159 in data exports.

160 The structure of SahulCHAR differs from the GPD in its approach to char sizes and measurement units. SahulCHAR specifies
161 the method of charcoal quantification (CHARMETHOD) for each record, with 11 methodologies for measuring charcoal and
162 black carbon particles included (see https://octopus-db.github.io/documentation/parent_tables.html#cabah-charmethodid-
163 fields). Char particle sizes in the GPD are embedded within the field for measurement units ('charcoal_units_name'), resulting
164 in a lengthy (176 options) but incomplete list of available units. To address this limitation, char sizes in SahulCHAR are distinct
165 from measurement units (CHARMEASURE) and entered separately as maximum (CHARMAX) and minimum values
166 (CHARMIN), along with the measurement unit for these size values (CHARSIZE_U). This allows for a restricted (35 options)
167 yet comprehensive list of measurement units that can be paired with any combination of size values, which may then be merged
168 into a single field during data migration to the GPD. This database structure also allows users to easily separate records by size
169 values for analysis.

170 While the CHARMEASURE field allows for a wide range of measurement units, volumetric (e.g., fragments/cm^3) rather
171 than influx (e.g., fragments/cm^2/year) measurements for char were preferred where possible during data compilation to allow
172 for recalibration and recalculation of age-depth models when necessary.

173 SahulCHAR contains char data from the following sources: original data contributed directly by authors; original data,
174 digitized data, and data of unknown origins contained in the GPD; original data contained in non-GPD databases (Neotoma
175 and PANGAEA); original data available in published supplementary materials; and records digitized from published diagrams.
176 Original char data from any source are classified in SahulCHAR as CHARSOURCE = 'author'. Data sourced from another

database either from digitization data or unknown origins are classified as 'paleofire database', and data digitized from published diagrams for SahulCHAR are classified as 'digitized'. Data were manually digitized for SahulCHAR using WebPlotDigitizer (Rohatgi, 2022). Char data from the GPD were exported via the web interface on 27 February 2023. Char data were last accessed from PANGAEA on 25 May 2023 and from Neotoma on 11 July 2023. While the RPD contains Australasian char data, these records were derived from the GPD. The methodology applied here involved assessing individual records from GPD and modifying, updating or correcting records where necessary based on local knowledge or discussion with original authors. Therefore, even though the RPD includes alternate chronologies and other modifications from GPD, this was not used for the SahulCHAR data compilation. Due to constantly evolving and updated chronological modelling and calibration techniques we have not included new chronologies for individual records and recommend re-calibration of age-depth models using the most appropriate and up to date methods for records included in SahulCHAR at time of use.

Table 3: Table representation of charcoal and black carbon metadata collected for SahulCHAR attributes vs corresponding GDP fields, where applicable. For full description of database tables refer to Munack et al. 2023.

Metadata field	Description	Field type	Example or available list	Corresponding GPD field
CORE	Name of collection unit, such as a core or excavation square	Free text	BWIL2	core_name
OBSID1	Unique identifier for observation	Text	BWIL2_char1_1	
SMPID	Unique sample identifier	Text	BWIL2_0.05	id_sample
DEPTH	Sample depth (mid-point) in metres	Numeric (in metres)	0.01	depth_value
THICKNESS	Sample thickness in centimetres	Numeric (in centimetres)	1	*NA*
EST_AGE	Estimated age for sample	Numeric (in years BP)	350	est_age_cal_bp
CALCURVE	Calibration curve used to generate estimated sample age	Predefined list	SHCal20	calibration_curve_version
CALPROGRAM	Calibration program used to generate estimated sample age	Predefined list	rbacon 2.3.2	calibration_method_type
CHARVALUES	Charcoal or black carbon values	Numeric	0.52	quantity
CHARMETHOD	Preparation method used for charcoal or black carbon analysis	Predefined list	pollen slide For full list; CHAR method-fields	charcoal_method_name

CHARMEASURE	Measurement units for charcoal or black carbon counts	Predefined list	frag/cm^3 For full list; Unit measures -fields	charcoal_units_name
CHARMAX	Maximum size for charcoal or black carbon	Numeric	250	*NA (included in 'charcoal_units_name')*
CHARMIN	Minimum size for charcoal or black carbon	Numeric	125	*NA (included in 'charcoal_units_name')*
CHARSIZE_U	Size units for maximum and minimum sizes	Predefined list	Mm For full list; Unit measures -fields	*NA (included in 'charcoal_units_name')*
CHARSOURCE	Source of charcoal or black carbon data (in field CHARVALUES)	Predefined list	Author For full list; Data source -fields	data_source_desc
REFDBID1, REFDBID2, REFDBID3	A unique identifier for associated references using the surname of the first author, year of publication, and a keyword (Name:YEARkeyword)	Text	Rehn:2020thesis, Rehn:2021cape	*NA*

3 Data summary

SahulCHAR Version 1 (V1; Rehn et al. 2024) contains 687 charcoal and black carbon ('char') records from 531 cores/samples (hereafter referred to as 'cores'), derived from 425 metasite locations across Sahul (Australia, New Guinea, and the Aru Islands) and New Zealand (Figure 2). The majority of metasites are from Australia (~64%), followed by New Zealand (~29%). Metasites show some geographic clustering, particularly in south-eastern Australia and the New Guinea Highlands, with large spatial gaps in central, western, and parts of northern Australia.

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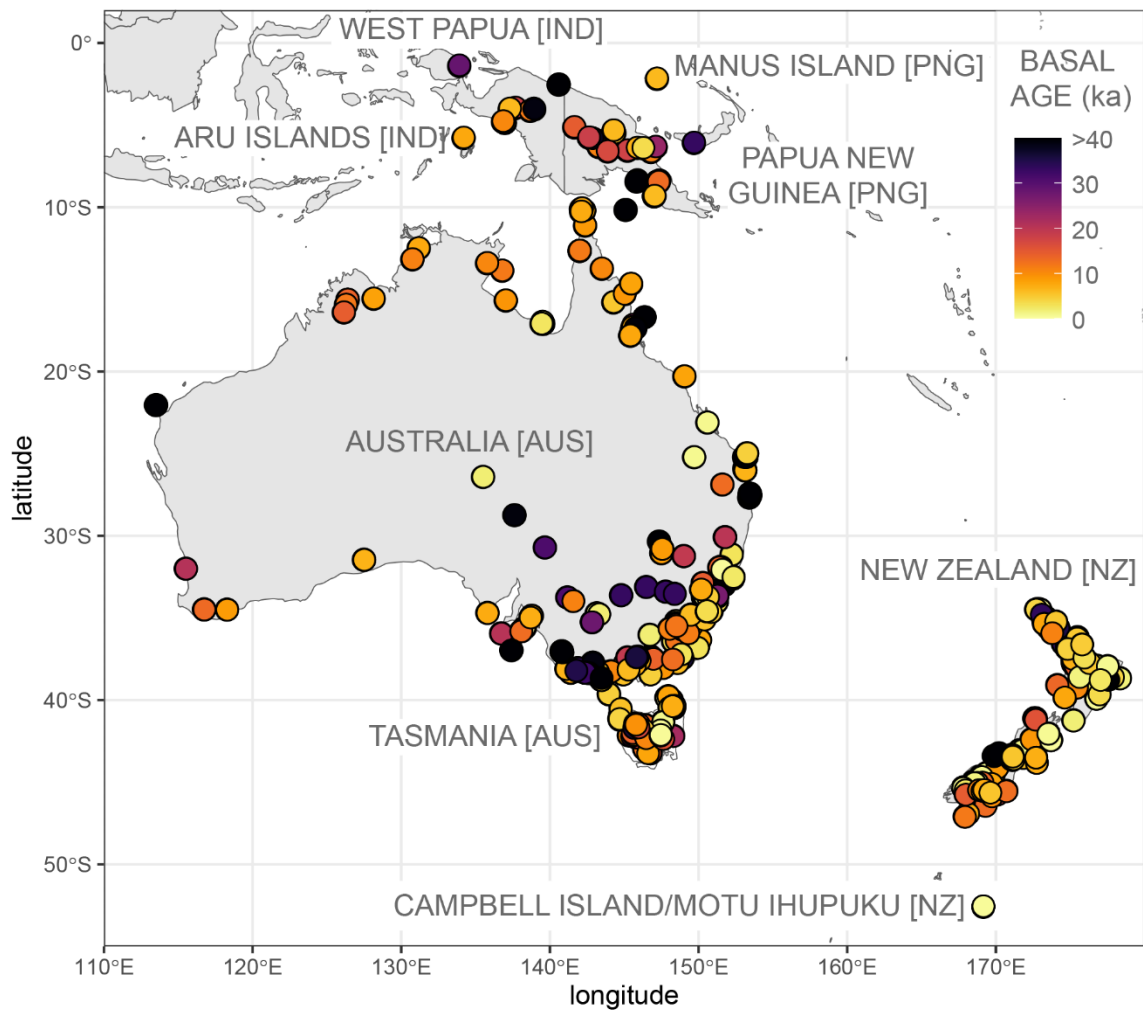
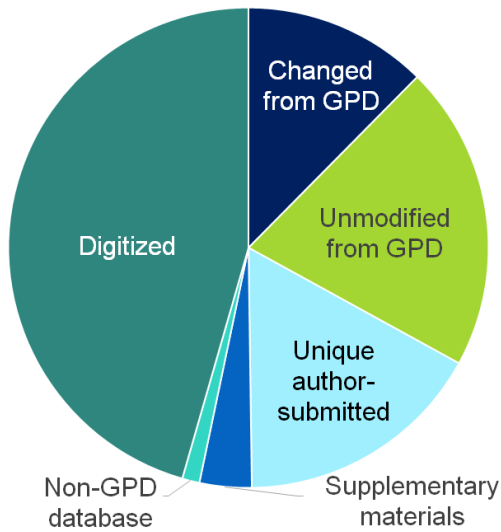
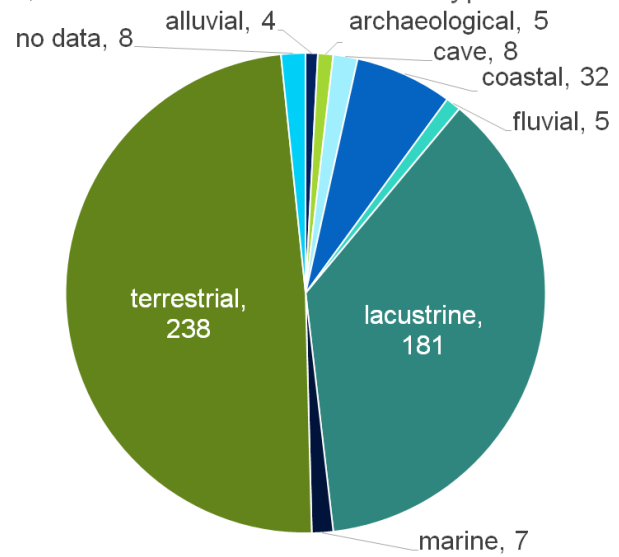


Figure 2: Sites with charcoal or black carbon records contained in SahulCHAR Version 1, with labels identifying major islands and their national affiliation in square brackets. Sites are coloured by the basal age (ka) of each record. Nation abbreviations: AUS: Australia, IDN: Indonesia, NZ: New Zealand, PNG: Papua New Guinea.

199

Original data were contributed directly to SahulCHAR by 23 authors, totalling 141 records. In cases where author-submitted data overlap with records that already exist in the GPD (27 records), preference was given to the author-submitted versions. Approximately 33% (211) of the records in SahulCHAR derive from, or also exist in, the GPD, with 85 records modified in some way (such as additional or corrected metadata) with reference to author-submitted information or source publications (Figure 3). Approximately 46% of records in SahulCHAR are digitized from published diagrams.

206   **Figure 3: SahulCHAR V1 a) sources of char records, and b) broad site types.**

207   The options for SITECODE in SahulCHAR include broad types (e.g., 'terrestrial', 'lacustrine') and broad types with specific

208   subcategories (e.g., 'terrestrial, bog', 'terrestrial, fen') stored in a self-referencing table with subcategories linked to their next

209   common denominators, respectively; for ease of comparison, sites are grouped into broad types in Figure 2b. Most sites in

210   SahulCHAR are broadly categorised as terrestrial (~49%, 238 sites), primarily bogs (107 sites), followed by lacustrine (~37%,

211   182 sites), primarily classified as lacustrine with no subcategories (154 sites). Categories in SITECODE are not exclusive and

212   may overlap (e.g., coastal lakes may be classified as coastal or lacustrine), with these classifications intended as a general

213   guide. Site characteristics may also change through time; SITECODE was determined based on site characteristics at the time

214   of sample collection. While archaeological sites were included, these were limited to charcoal quantification undertaken as

215   part of palaeoenvironmental analyses to exclude charcoal potentially associated with archaeological features (e.g., hearths).

216   These archaeological sites were further limited to records where associated depth values were available for char measurements;

217   archaeological sites with char data associated with stratigraphic (SU) or excavation (XU) units without specified depths were

218   excluded.

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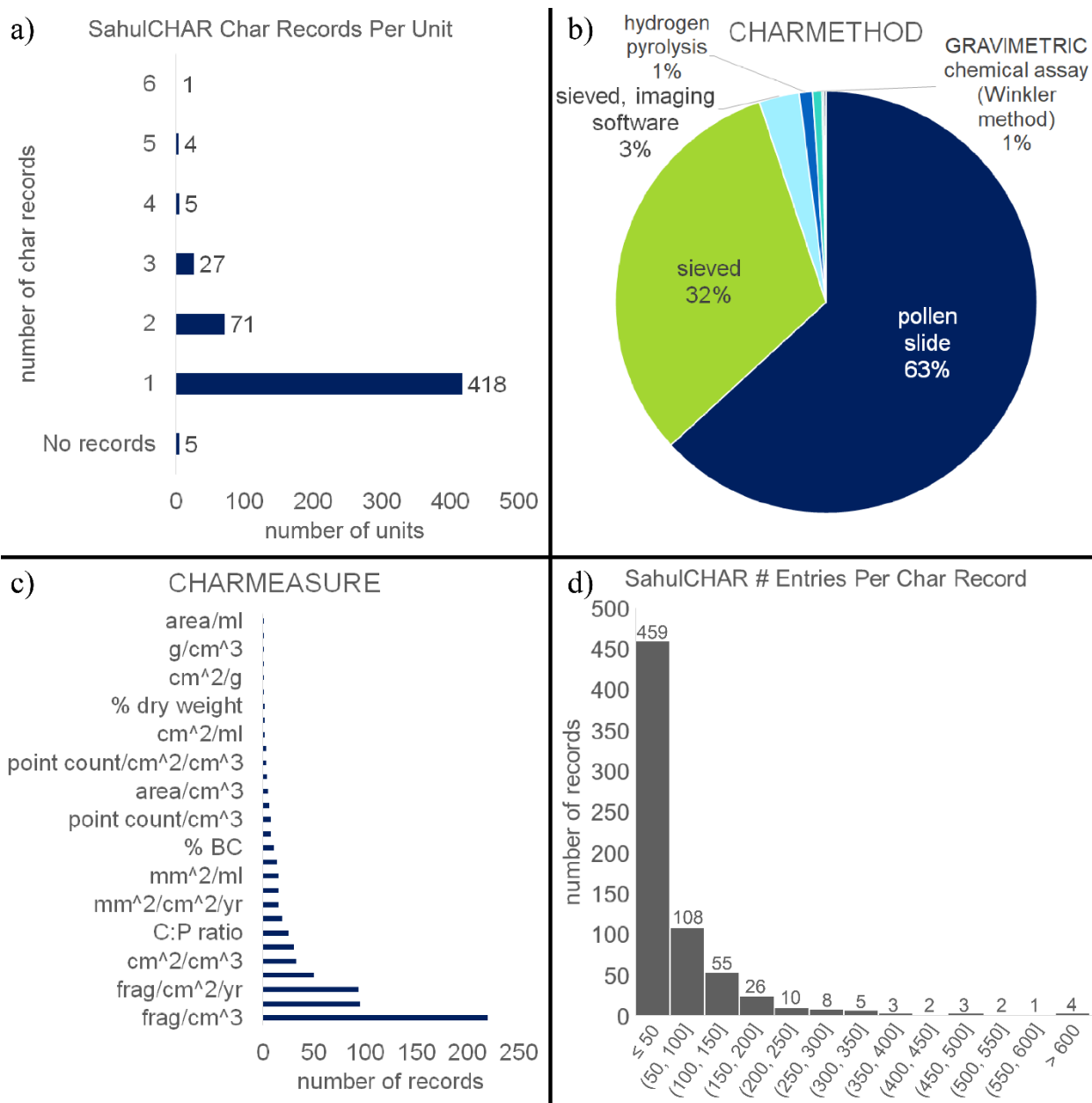
Figure 4: SahulCHAR V1 char data summaries: a) number of char records per UNIT with instances of multiple records from a single core representing different char sizes, analysis methods, or measurement units, b) sample preparation method for char records, c) measurement units (for a full list of measurement units and associated abbreviations, see https://octopus-db.github.io/documentation/parent_tables.html#global-varunitid-fields), and d) number of entries (sample depths) per char record.

225 A total of 3271 ages are contained in SahulCHAR V1. The majority (~77%) of cores have 1-10 associated ages, and 34 units
226 (~6%) have no available age data. In instances where no ages are available from a unit with associated charcoal data, other
227 dated units from the same site have been included where possible (5 units, from metasites Lake George and Blue Lake
228 Kosciuszko, both in New South Wales, Australia).

229 Most UNIT entries have one associated char record (418 cores, ~79%) up to a maximum of six associated records (1 core,
230 'MAR2' from metasite Marura) (Figure 4). The majority (~63%, 432 records) of char records in SahulCHAR are derived from
231 pollen slides, followed by sieved samples (~32%, 217 records). Pollen slide charcoal also dominated the dataset compiled by
232 Mooney et al. (2012), although sieved charcoal is slightly better represented in SahulCHAR (compared to ~80% and ~20%,
233 respectively, in Mooney et al., 2012, p. 18). Approximately 32% (220 records) of the char records in SahulCHAR are measured
234 in "frag/cm^3", followed by "% of pollen sum" (~14%, 95 records) and "frag/cm^2/yr" (~14%, 94 records). Over half (~54%)
235 of the char records specify a size range for particles, with 54 unique size ranges specified; this demonstrates both the utility of
236 isolating maximum and minimum particle sizes from measurement units to allow for this variability, and the diversity of
237 approaches used to create these records. All char records contain a minimum of three entries, and most char records (~67%)
238 contain 50 entries or less. The highest number of entries for any char record is 881 ('WL15-2_char1' from Welsby Lagoon).

239 **4 Conclusions and future work**

240 SahulCHAR is the most comprehensive and up-to-date palaeofire database for Sahul and New Zealand (Rehn et al. 2024), and
241 an overdue step towards improved representation of Australasia in global syntheses. The latter goal will be addressed through
242 upcoming integration with the GPD as part of the planned conversion of the GPD into a constituent database of Neotoma
243 Paleoecology Database (Dietze and Vannière, 2022). As an update to the last Australasian compilation (Mooney et al., 2011,
244 2012, which covered a slightly larger geographic area than SahulCHAR), SahulCHAR triples the number of char records
245 available for the region and incorporates data from numerous new studies produced over the last decade. SahulCHAR follows
246 the FAIR principles of scientific data management and stewardship (Wilkinson et al., 2016) and the OPEN data requirements
247 of funding agencies, such as the Australian Research Council, to make publicly funded data freely available.

248 Data creators in the region are encouraged to contribute records either directly to SahulCHAR or to the GPD within Neotoma.
249 Future versions will ideally shift the balance of char sources away from digitized data, with a greater representation of author-
250 contributed original data. Future work relating to SahulCHAR Version 1 will provide a synthesis and analysis of the records
251 in the dataset to explore trends in palaeofire regimes across the region, and could also explore metadata associated with each
252 record to understand changing approaches to charcoal analysis over time.

253 Data creators with char records from Australia, New Guinea, or New Zealand that they would like to contribute can use a
254 SahulCHAR data template (10.5281/zenodo.10117180; Rehn, 2023) and can contact Dr Haidee Cadd (haidee@uow.edu.au)
255 with enquiries or to submit completed data templates.

Data availability statement

257 The data in this study are openly available at http://dx.doi.org/10.25900/KKDX-XH23 (Rehn et al. 2024) and via the Octopus
258 database https://octopusdata.org/ (last accessed 28th August 2024; Codilean et al. 2022). Additional information about the
259 SahulCHAR database collection and the data can be accessed at: http://dx.doi.org/10.25900/KKDX-XH23.

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Competing interests

264 The authors declare that they have no conflict of interest.

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